REPORT DOCUMENTATION PAGE

Form Approved OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	9 Apr 1997	Final

4. TITLE AND SUBTITLE
Advanved Distributed Simulation Technology II (ADST-II)
TF XXI Digitial Trainning exercise Final Report

5. FUNDING NUMBERS
N61339-96-D-0002

6. AUTHOR(S)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Lockheed Martin Corporation
Information Systems Co.
12506 Lake Underhill Road
Orlando, FL 32825

8. PERFORMING ORGANIZATION REPORT NUMBER
ADST-II-CDRL-TFXXID-9700125

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

NAWCTSD/STRICOM
12350 Research Parkway
Orlando, FL 32826-3224

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
A - Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 Words)***

The Task Force XXI Digital Training Exercise (DTX) was conducted at the AViation Test Bed (AVTB) at Fort Rucker, AL from February 5 to February 10, 1997. The exercise was conducted as Delivery Order (DO) #0030 under the Lockheed Martin Advanced Distributed Simulation Technology II (ADST II) Contract administered by the U.S. Army Simulation Training and Instrumentation Command (STRICOM). The exercise was sponsored by the Directorate of Training, Doctrine and Simulation (DOTDS), U. S. Army Aviation Center, Fort Rucker, AL. The training exercise utilized virtual simulations integrated with a tactical command and control network to provide training for the TF XXI AViation task force. An AViation task force Tactical Operations Center (AVTOC), Army Airborne Command and Control System (A2C2S), and higher and lower white cells were integrated on a tactical Local Area Network (LAN). A Distributed Interactive Simulation (DIS) LAN was established consisting of manned simulators and Semi Automated forces. The two LANs were connected via the Tactical Simulation Interface Unit (TSIU). Three training scenarios were utilized to train the command and control processes of the 2-4 Aviation Task Force Staff. The scenarios were designed to stress the task forces command and control process in order to prepare the unit for an upcoming TF XXI rotation 97-07 at the National

14. SUBJECT TERMS
ADST-II;STRICOM;TF XXI; DTX; simulation;

15. NUMBER OF PAGES
30

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

ADVANCED DISTRIBUTED SIMULATION TECHNOLOGY II (ADST II)

TF XXI DIGITAL TRAINING EXERCISE

DTX #0030

CDRL AB01

FINAL REPORT

FOR: NAWCTSD/STRICOM
12350 Research Parkway
Orlando, FL 32826-3224
N61339-96-D-0002
DI-MISC-80711

BY: Lockheed Martin Corporation
Martin Marietta Technologies, Inc.
Information Systems Company
12506 Lake Underhill Road
Orlando, FL 32825

Document Control Information

Revision	Revision History	Date
	Initial Release	4/10/97

List of Figures

Executive Summary

The Task Force XXI Digital Training Exercise (DTX) was conducted at the AViation Test Bed (AVTB) at Fort Rucker, AL from February 5 to February 10, 1997. The exercise was conducted as Delivery Order (DO) #0030 under the Lockheed Martin Advanced Distributed Simulation Technology II (ADST II) Contract administered by the U.S. Army Simulation Training and Instrumentation Command (STRICOM). The exercise was sponsored by the Directorate of Training, Doctrine and Simulation (DOTDS), U. S. Army Aviation Center, Fort Rucker, AL. The training exercise utilized virtual simulations integrated with a tactical command and control network to provide training for the TF XXI AViation task force. An AViation task force Tactical Operations Center (AVTOC), Army Airborne Command and Control System (A2C2S), and higher and lower white cells were integrated on a tactical Local Area Network (LAN). A Distributed Interactive Simulation (DIS) LAN was established consisting of manned simulators and Semi Automated forces. The two LANs were connected via the Tactical Simulation Interface Unit (TSIU). Three training scenarios were utilized to train the command and control processes of the 2-4 Aviation Task Force Staff. The scenarios were designed to stress the task forces command and control process in order to prepare the unit for an upcoming TF XXI rotation 97-07 at the National Training Center.

This final report addresses the simulation, tactical, and communications networks developed to support the training exercise. The *STRICOM Feasibility Analysis Study (FAS) for the Task Force XXI Aviation Task Force Digital Training Exercise* provided the architectural framework for the tactical and simulation LANs. Engineering integration was originally scheduled to be performed at the Operational Support Facility. However, due to time constraints, all integration was performed at the AVTB during a two and one half week period. Government Furnished Equipment (GFE) and Government Furnished Information (GFI) for the tactical network was provided the week of 13-17 January by the Central Technology Support Facility (CTSF) at Fort Hood Texas. The installation of the Army Airborne Command and Control System Maneuver Control System (MCS) was performed at the Naval Research Laboratories (NRL) from 13-17 January and installed at the AVTB on 23-24 January. The Tactical Simulation Interface Unit (TSIU) was installed by Coleman Research Corporation (CRC) 22-24 January and continually developed throughout the integration period. This document does not address the performance of the Aviation Task Force during the training exercise.

1. INTRODUCTION

1.1 Purpose

The purpose of this final report is to document the ADST II effort which supported the TF XXI Digital Training Exercise and specifically capture the exercise network configurations, observations, and lessons learned. This document does not address the operational effectiveness of the various systems or specific results of the training exercise.

1.2 Contract Overview

TF XXI DTX was performed as DO #0030 under the Lockheed Martin Corporation (LMC) ADST II contract with STRICOM. The contract required LMC to implement the STRICOM FAS for the Aviation Task Force XXI Digital Training Exercise.

1.3 Exercise Overview.

The purpose of the TF XXI DTX was to support the training of the Task Force 2-4 Aviation in the command and control on the digital battlefield prior to their NTC rotation 97-07 as part of the Task Force XXI Advanced Warfighting Experiment. The exercise utilized the simulated environment to stimulate the digital tactical command and control systems. Specifically, manned simulators rounded out with ModSAF, the Extended Air Defense Simulation (EADSIM) and ITEMS provided a simulated tactical environment. The Tactical Simulation Interface Unit (TSIU) provided a bridge from the simulated world to the tactical world which stimulated the Army Tactical Command and Control Systems (ATCCS) by taking information from the simulated environment through protocol data units (PDU's) and creating Variable Message Formats (VMF). This message traffic was representative of the types and volumes of messages this unit could expect on the digital battlefield.

2. APPLICABLE DOCUMENTS

2.1 Government

Feasibility Analysis Study (FAS) for the TF XXI Aviation Task Force Digital Training Exercise, STRICOM-ED-DTX FAS.

ADST II Statement of Work for the Task Force XXI Digital Training Exercise (DTX) Delivery Order Version 3.0, AMSTI-96-W088, 10 October 1996.

2.2 Non-Government

None

3. Systems Description

3.1 System Configuration and Layout

The AVTB supported the integration of an AVTOC, A2C2S, and higher and lower white cells for the tactical network as well as ModSAF, SIMNET RWA's, ARMS Device, Kiowa Warrior Player Station, Longbow Player Station, SINCGARS radio models, as well as ASTi radio models for the DIS network. Figures one and two depict the physical layout of the AVTB in support of the exercise. The AVTOC served as the focal point for the planning cell of the aviation task force. The A2C2S housed the battalion commander during the conduct of the mission. The white cells housed the higher (Brigade and Division) and lower (Company) planning elements.

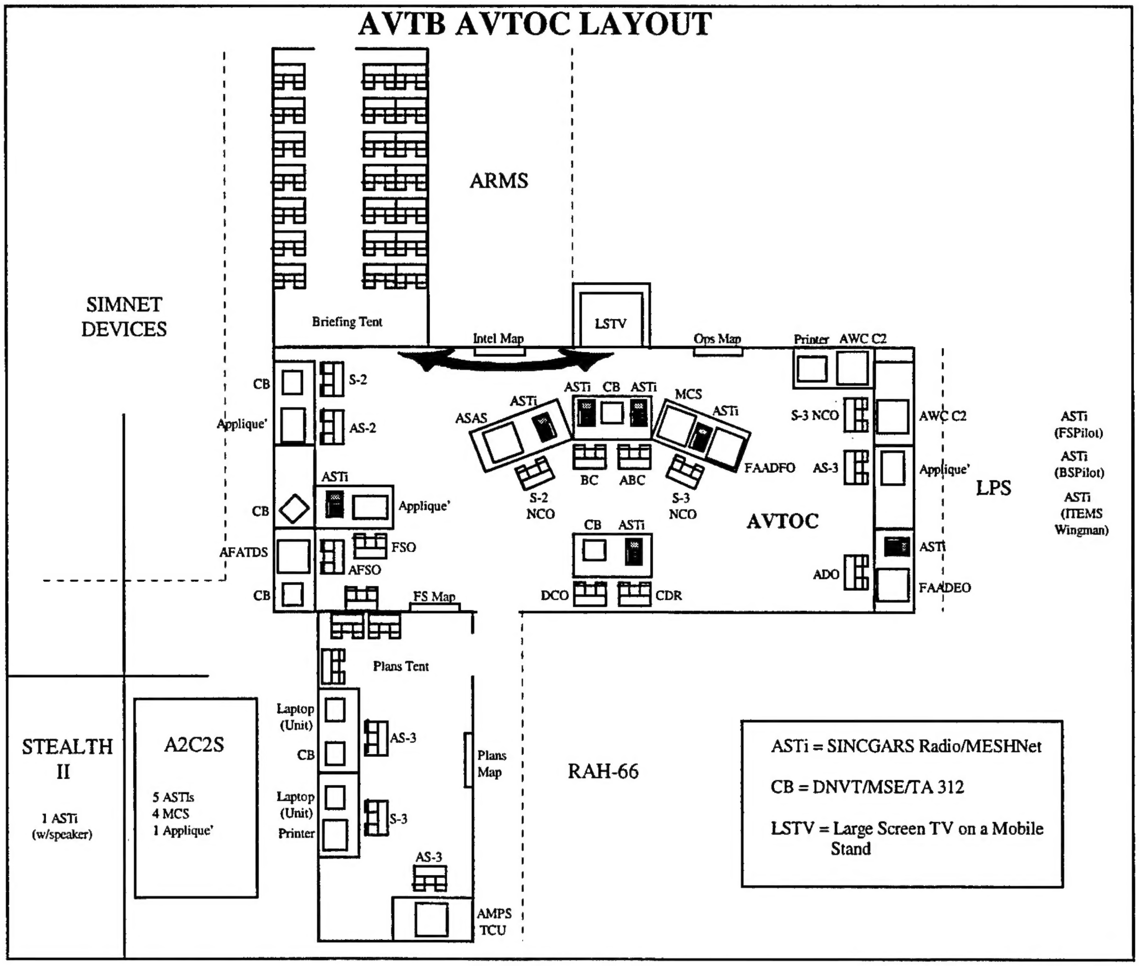

Figure 1 AVTOC Site Layout

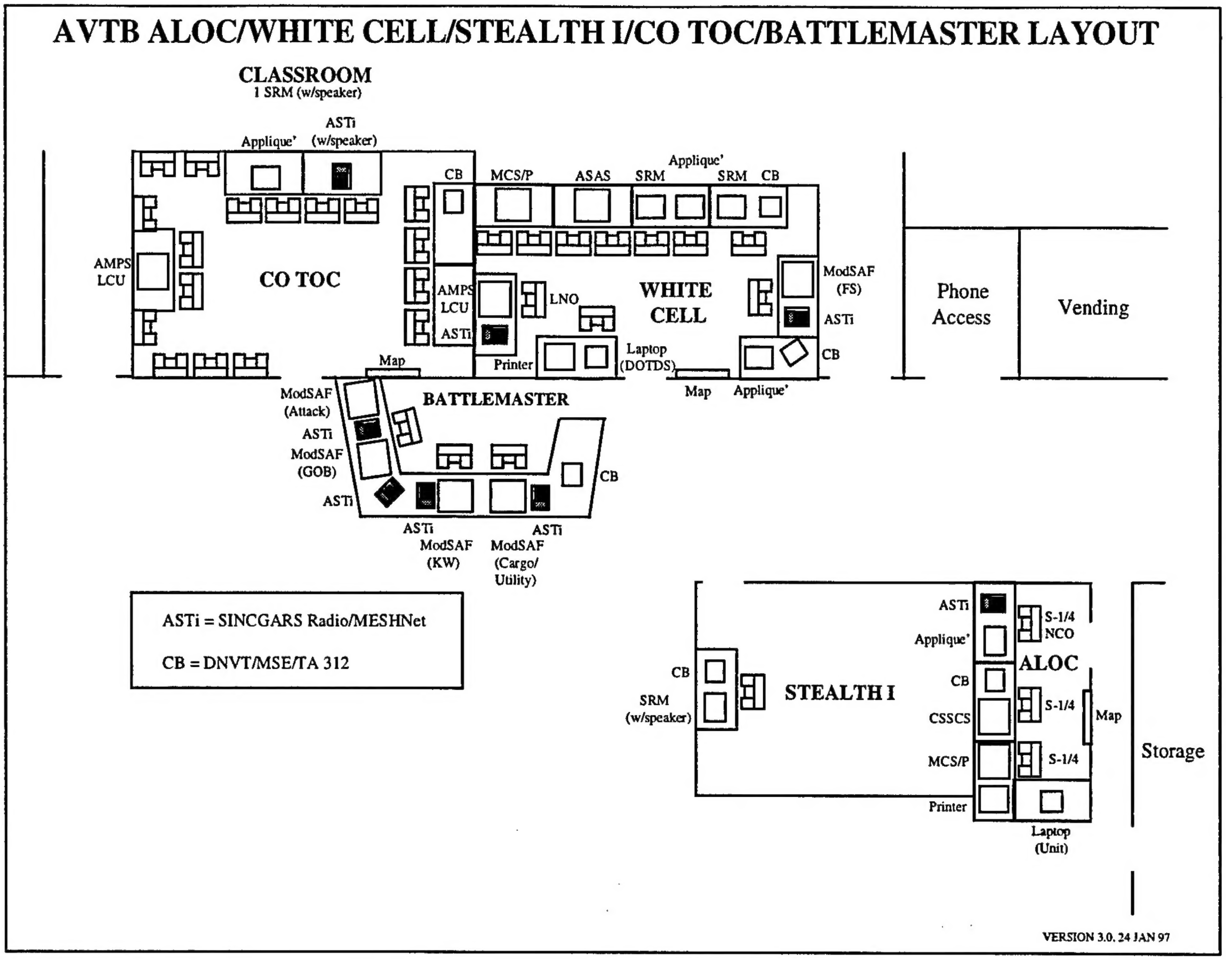

Figure 2 White Cells and ALOC Layout

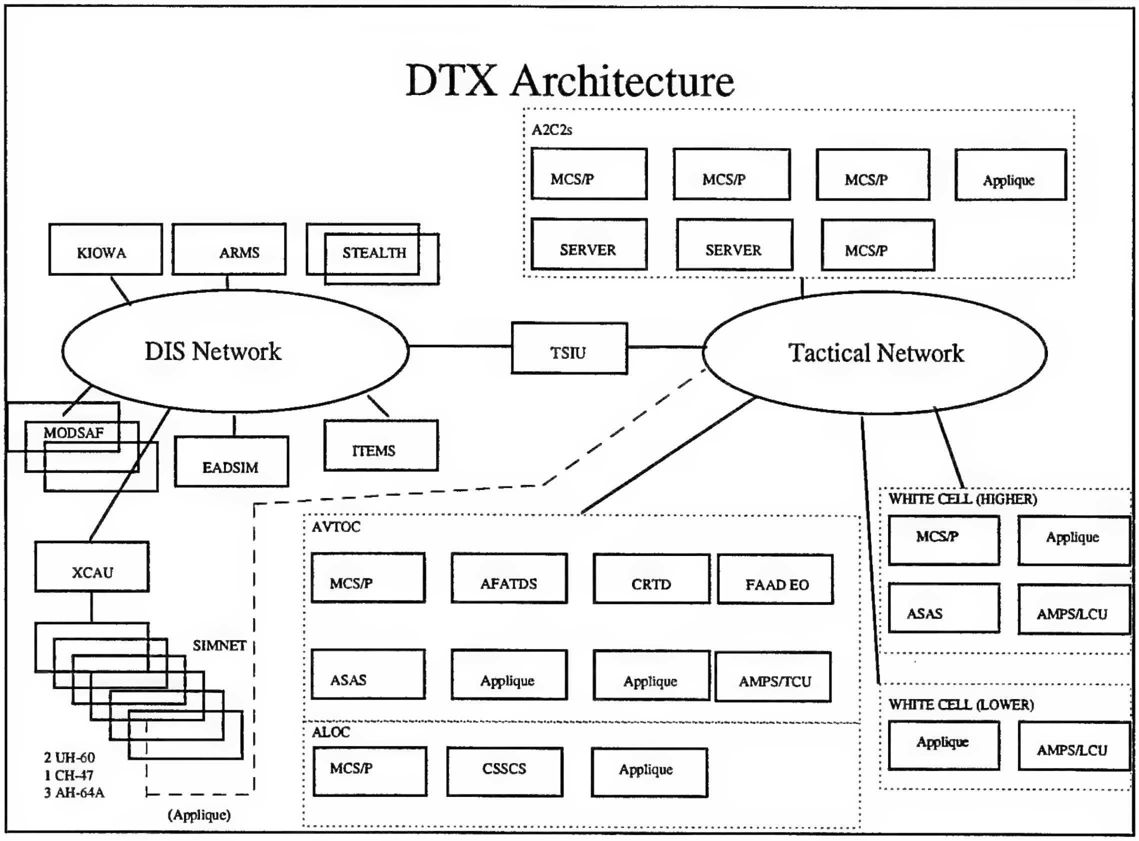

Figure 3 Network Architecture

3.1.1 Tactical Network Systems Description

The tactical network supported the ATCCS systems listed below. The software for these systems were provided by the TF XXI CTSF. The January 9 1997 version of the ATCCS software was provided along with TF XXI Address Book Version 3.6a. The software was loaded directly to 4 GB hard drives by the CTSF personnel. System configuration was performed at the AVTB by LMC engineers. The Fort Hood TF XXI architecture makes use of a router between all ATCCS systems to facilitate ease of movement of their systems. The DTX architecture eliminated the use of routers. The ATCCS systems were integrated on one LAN using 10 base T ethernet cable. The network was setup using a client-server relationship which allowed for sharing of information between systems. The following is a brief description of each of the ATCCS system. Figure three depicts the tactical network integrated with the DIS LAN. The following is a brief description of the tactical systems.

3.1.1.1 All Source Analysis System (ASAS)

ASAS serves as the primary system for conducting Intelligence Preparation of the Battlefield (IPB) for all echelons and for updating the intelligence picture of the battlefield during the mission. For the DTX exercise, two ASAS systems were integrated via the Tactical LAN utilizing the Task Force XXI January 9, 1997 release version; one in the S2 section of the AVTOC and one in the Higher Headquarters white cell. Within the AVTOC, ASAS was

configured as a server. ASAS was installed on a Sun SPARC 20 with 448 MB RAM two 4 GB hard drives utilizing the Sun Solaris v2.4 operating system.

3.1.1.2 Appliqué

Appliqué provides situational awareness and C2 messages via a tactical network to units adjacent and above in the chain of command. For the DTX, eleven appliqués were integrated into the tactical network. One appliqué was located in the A2C2S; one each in the higher and lower white cells; one in the ALOC; one in the ARMS device; one in the KWPS; two in the AVTOC; and three in the RWA devices. Perfect communications were assumed between appliqués eliminating the requirement for the TIM and INC models. Integration of the appliqués with the DIS network was originally designed via the JCIT. However the JCIT software was not deemed mature enough to handle the message traffic. It was subsequently decided to use the Appliqué Interface Software developed for FPE III. However, this software was not robust enough to interface above the platoon level and at DIS 2.04. It was then decided that position reporting would be manually entered throughout the exercise. Appliqué was hosted on a Compaq Laptop LTE Elite 5150 notebook computer upgraded to 24 MB RAM, 775 MB hard drive with a mouse trackball using the SCO Unix operating system.

3.1.1.3 Advanced Field Artillery Tactical Data System (AFATDS)

AFATDS serves as the primary field artillery information system for the task force. The Corps or Division Artillery Brigade formulates the fire support plan and disseminates this plan via the MCS system. The Aviation Brigade and Battalion TOCs nominates targets and submits requests for fire support. The AFATDS system was located in the AVTOC with the task force fire support officer. The AFATDS was hosted on a HP 735 with 256 MB RAM and a 2 GB hard drive operating HP/UX 9.0

3.1.1.4 Combat Service Support Control System (CSSCS)

The CSSCS is a computerized system for the control of most classes of supplies, equipment, and personnel replacements. The CSSCS provides information on the status of nits and equipment to the MCS computer for transmission to users over the area common user system. The Aviation Brigade Administration and Logistics Operations Center (ALOC) uses CSSCS software on a common computer to perform administrative and logistics requests and reporting functions. Battalion and Brigade ALOCs are in the network to receive a common picture of the battlefield via the ALOC MCS. For the DTX, CSSCS was integrated via the tactical LAN and located in the ALOC. The TF XXI 9 January 1997 release was hosted on a SUN Sparc 20 with a 4 GB hard drive and 256 MG of RAM running the SUN Solaris vs 2.4 operating system.

3.1.1.5 Maneuver Control System (MCS)

The Maneuver Control System serves as the focal point for the Army Tactical Command and Control Systems (ATCCS). MCS depicts the maneuver Battlefield Functional Area (BFA) and serves as the integration point that all BFA systems (CSSCS, AFATDS, FAAD, and ASAS)

interface. For the DTX, a total of seven MCS's were integrated via the Tactical LAN. The January 9,1997 Fort Hood TF XXI version of MCS was utilized. Four MCS systems were located in the A2C2S providing the Air Mission Commander with a view into the battlefield. One MCS was located in the S3 section of the AVTOC; one MCS was locate in the higher white cell, and one MCS was located in the ALOC. Roles for each other systems were assigned using the TFXXI Address Book Version 3.6a(FINAL). All of the MCS systems were operating on SUN Sparc 20 system with 4GB hard drives and 256 MB of RAM using the SUN Solaris 2.4 operating system. Internal floppy 3 1/2 in floppy drives were installed in the AVTOC MCS and higher headquarters MCS to allow for copying of information to disks.

3.1.1.6 Forward Area Air Defense Engagement Operations (FAADEO)

The FAAD system provides an overview of the area air defense picture. The FAAD system takes information from Air Force, Navy, and other national assets to formulate the common air picture. This information is typically transmitted over the Enhanced Position Location Reporting System (EPLRS) throughout the FAAD network. The FAAD system was located in the AVTOC. For the DTX, the FAAD EO was hosted on a SUN Sparc 20 with 256 MB RAM, 4 GB Hard drive operating the Sun Solaris 2.4 operating system.

3.1.1.7 Aviation Mission Planning System (AMPS)

The AMPS is a graphical user interface mission planning tool that automates aviation mission planning tasks. At the company/troop level, the AMPS is used to generate mission data for use in either hard copy or electronic formats. As a subordinate of the MCS, AMPS is integrated to provide functionality to assist in improving battlefield synchronization/intelligence in the tactical command and control arena. For the DTX, AMPS was integrated via the Tactical LAN into the AVTOC, the company level white cell and the higher headquarters white cell. A SUN Sparc 20 served as the platform for the AVTOC AMPS. A ruggedized Lightweight Computer Unit (LCU) provided by USAAVNC was integrated into the higher and lower white cells.

3.1.2 Distributed Interactive Simulation (DIS) Network Systems Description

The following systems operated on the DIS network during the exercise. DIS version 2.04 was used throughout the exercise. The simulated environment served as the stimulus fro the command and control systems for the exercise.

3.1.2.1 SIMNET Rotary Wing Aircraft (RWA) Simulators

The ADST II Rotary wing aircraft is a reconfigurable real-time simulation. The simulator can be modeled as an OH-58, AH-64, or former Soviet Union helicopters. The RWA has the capability to model a 30mm cannon, Hellfire missiles, the Air to Air Stinger (ATAS), the TOW missile, a 50 caliber machine gun, the hydra 70 rocket and former Soviet Union counterpart munitions. The RWA has three seats two of which are manned at any given time, by the pilot and copilot observer or gunner. The simulator consists of a singular compartment manned by two crew members. All simulated vision devices within the aircraft are controlled

by a GT111 computer image generator. The simulated sensors include the Day TV and the FLIR.

Vulnerability is simulated in the RWA as combat damage assessment performed when the simulated aircraft receives hit information from a direct fire source or an indirect fire source on the simulation network. Vulnerability assessment is a function of round type, location of hit, range of firer from the impact

For the DTX, 3 RWA's were configured as AH-64 Apache aircraft. The aircraft were equipped with varying weapons loads of Hellfire missile, 30mm cannon, and ATAS. Two RWA's were configured as UH-60 aircraft and one RWA was configured as a CH-47.

3.1.2.2 Kiowa Warrior Player Station

The KWPS is a Man-in-the Loop mission equipment trainer for the OH-58D. The trainer is located in the Army Research Institute Rotary Wing Aviation Research Unit at Fort Rucker. The KWPS linked into the AVTB via a fiber optic cable using the DIS 2.04 protocol. The KWPS was equipped with an appliqué for the mission and assumed the role of a member of a scout platoon leader for the DTX missions.

3.1.2.3 Aviation Reconfigurable Manned Simulator (ARMS)

The ARMS device is a proof-of-principle manned simulator that allows for configuration as a UH-60, OH-58D, or AH-64. The ARMS provides a unique platform to analyze the simulation and training fidelity requirements for future production of ARMS devices. In order to serve this function, various equipment/systems have been assembled and connected in a manner to produce a form of training consistent with the customer's requirements. The test cell incorporates components that support training through effective visual and instrument presentations, control loading, motion (seat vibration), navigation, and communications. The components are designed in such a manner that they can be effectively reconfigured by replacing cyclics, collectives, and the touch screen glass instrument panel to represent the UH-60A, OH-58D, and the AH-64A. Weapons delivery is available for the appropriate configurations and all aircraft are subject to attack. The device includes both a helmet mounted display (HMD) and out the window (OTW) configuration for the pilot position. The Copilot Gunner station has an out the window and head-down sensor display system. For the DTX, the ARMS was configured as a OH-58D serving as a troop commander. The device operated on the DIS 2.04 network.

3.1.2.4 Longbow Player Station (LPS)

The Longbow Player Station the AVTB Advanced Warfighting Cell is a DIS Man-in-the Loop simulator. The LPS operated at DIS 2.04 for this exercise. Throughout the exercise the LPS experienced difficulty coming up and remaining on the network. The cause of the reliability problems were not fully identified during the exercise.

3.1.2.5 Extended Air Defense Simulation (EADSIM)

EADSIM is a DIS compliant simulation that provides computer generator forces for the battle. EADSIM specifically provides the sensor picture to provide the overall air picture of the battle. For the DTX, EADSIM ran on an SGI Indigo II with a 2 GB hard drive and 96 MB of RAM using Irix 5.2 at DIS 2.04.

3.1.2.6 Translator Cell Adaptor Unit (XCAU)

The XCAU consists of a workstation and associated software that allows DIS simulators to interoperate with SIMNET simulators within the constraints of translated PDUs. The XCAU provides two parallel protocol translation processes: translation of DIS to SIMNET, and SIMNET to DIS. No software changes were made to the XCAU in support of the ZDTX. The host system for the XCAU was an SGI Indigo 2 with 128 MB RAM, 2 GB hard drive, utilizing the Irix 5.2 Operating System.

3.1.2.7 Stealth

The ADST II Stealth gives the Observer/Controller (O/C) personnel a "window" into the virtual battlefield, allowing them to make covert observations of the action occurring during the scenario. In addition, through the use of the data logger, the Stealth gives observers and analysts an After Action Review(AAR) capability. The Stealth is a visual display platform that consists of a PVD, various input devices, and a video display that provides the operator with a panoramic view of the battlefield.

The Stealth permits the controller to fly around the virtual battlefield and view the simulation without interfering with the action. The features of the Stealth allow the observer to survey the virtual battlefield from a variety of different perspectives, including:

a. Tethered View - Allows the user to attach unnoticed to any vehicle on the virtual battlefield.

b. Mimic View - Places the user in any vehicle on the virtual battlefield and provides the same view as the vehicle commander.

c. Orbit View - Allows the operator to remain attached to any vehicle on the virtual battlefield and to rotate 360° about that vehicle, while still maintaining the vehicle as a center point of view.

d. Free Fly Mode - Permits independent 3-D movement anywhere in the virtual battlefield.

3.1.2.8 Data Logger

The Data Logger is an ADST II asset that captures the network traffic and places the data packets on a disk or tape file. The Data Logger performs the following functions:

a. Packet Recording - Receives packets from the DIS or SIMNET network, time stamps and then writes to a disk or tape.

b. Packet Playback - Packets from a recorded exercise can be transmitted in real time or faster than real time. The Data Logger can also suspend playback (freeze time) and skip backward or forward to a designated point in time. The logger can be controlled directly from the keyboard or remotely from the PVD. Playback is visible to any device on the network (PVD, Stealth Vehicle, a vehicle simulator, etc...).

c. Copying or Converting - Files are copied to another file, which can be on the same or a different medium; and files from the older version of the Data Logger can be converted to a format compatible with the current version of the Data Logger.

For the DTX, two data loggers were employed to capture the exercise. These two loggers were hosted on SGI Indys with 96 MB RAM, 1 GB hard drive, utilizing the Irix 5.2 operating system.

3.1.2.9 SINCGARS Radio Simulation/Emulator

The simulation of the SINCGARS radio provided the means of communications between the players. The SRM and the SRE are ADST II program assets that simulate realistic propagation effects consistent with the performance that a user could expect from the actual SINCGARS system in a real-world application. They are capable of transmitting/receiving voice and data messages from other SRMs/SREs.The SRE is a hardware/software system that contains the SRM radio core software model. The SRE is based on the SINCGARS / Combined Arms Command and Control (CAC2) simulator. The SRE provides a realistic SINCGARS user interface, input/output system, and intercom communications. The DIS network interface allows the radio to communicate to other radios using DIS v2.04 standard transmitter and Signal PDUs. The network interface monitors entity state PDUs to determine the own-vehicle radio's antenna location and vehicle status.

For the DTX, 12 SINCGARS radio models were provided by the ADST II program. These models were hosted on an SGI Indy with 96MB RAM, 1 GB hard drive, utilizing the Irix 5.2 operating system.

3.1.2.10 Advanced Simulation Technologies incorporated (ASTi) Radio Simulation

The ASTi Digital Audio Communication System (DACS) is a commercial of the shelf radio product that provides digital voice communication. The ASTi DACS utilizes DIS PDUs to simulate the radio sound environment. The ASTi DACS are able to interoperate with the SRM/SRE. The simulation consists of a pentium based simulator with Hand-Held Terminal Units and headsets. For the DTX, ASTi DACS were the means of communication for the aviation staff. Table one depicts the communication matrix for the exercise and the corresponding simulation used for each player.

Entity	Position	Radio Type	Higher Ops	HIGHER CMD	HIGHER INTEL	HIGHER ADA	HIGHER FS	FS NET	ATF CMD	ATF OPS/ITNEL	CO CMDRS	INTER-COM	Notes
A2C2S												T/R	One Entity, 7 Frequencies, 5 Operators
	CDR	ASTi	T/R	T/R					T/R	T/R		T/R	
	S-2	ASTi			T/R				T/R	T/R		T/R	Intercom is specific to A2C2S
	S-3	ASTi	T/R	T/R	T/R				T/R	T/R		T/R	
	FSO	ASTi		T/R			T/R	T/R	T/R			T/R	
	Sys Adm	ASTi										T/R	
AVTOC/ ALOC													One entity, 9 fequencies, 8 Operators
	BC	ASTi		T/R								T/R	
	ABC	ASTi							T/R			T/R	**Intercom is shared by AVTOC and ALOC which are a single entity.**
	S-3 NCO	ASTi	T/R								T/R	T/R	
	S-2 NCO	ASTi			T/R					T/R		T/R	
	FSO	ASTi					T/R	T/R					
	ADA	ASTi				T/R						T/R	
	CDR	ASTi										T/R	
	S1/S4 (ALOC)	ASTi		T/R					T/R	T/R	T/R	T/R	Intercom is shared between AVTOC and ALOC
CGF LPS	Wing-man, ITEMS	ASTi						T/R	T/R	T/R	T/R		
LPS	Front Reat	ASTi						T/R	T/R	T/R	T/R	T/R	1 entity, 5 frequencies, 2 operators
	Rear Seat	ASTi						T/R	T/R	T/R	T/R	T/R	
Co TOC													1 entity, 3 frequencies, 2 operators
	POS A	ASTi							T/R	T/R	T/R		**Needs a speaker (1)**
White Cell													White Cell and Stealth 1 are one entity.
	LNO	ASTi	T/R	T/R					T/R	T/R			entity, 2 frequencies, 1 operator
	POS A	SRM	T/R	T/R	T/R	T/R	T/R	T/R					Set 2 SRMs to monitor 4 of the 5 nets simultaneously

	POS B	SRM	T/R	T/R	T/R	T/R	T/R	T/R					
ModSAF FS @ White Cell		ASTi					T/R	T/R			T/R		1 entity, 3 frequencies, 1 operator, Box 5
Higher CMR (Stealth 1), same entity as White Cell	Higher CMR	SRM	T/R	T/R	T/R	T/R	T/R	T/R	T/R	T/R	T/R		**Need Speaker (2)**
Stealth 2 (Not an actual Battlefield entity)		ASTi	R	R	R	R	R	R	R	R	R		**Need Speaker (3)**
Utility ModSAF Operator @ Battlemaster Station	Utility (BM)	ASTi						T/R	T/R	T/R	T/R		1 entity, 3 frequencies, 1 operator
Attack ModSAF Operator @ Battlemaster Station Attack	Attack (BM)	ASTi						T/R	T/R	T/R	T/R		1 entity, 3 frequencies, 1 operator

Entity	Position	Radio Type	Higher OPS	HIGHER CMD	HIGHER INTEL	HIGHER ADA	HIGHER FS	FS NET	ATF CMD	ATF OPS/ITNEL	CO CMDRS	INTER-COM	Notes
Kiowa ModSAF Operator @ Battlemaster Station	Kiowa (BM)	ASTi	T/R	T/R				T/R	T/R	T/R	T/R		1 entity, 34 frequencies, 1 operator
ModSAF Operator, GOB (Not an entity)	Located at BM Station	ASTi	T/R	T/R	T/R			T/R	T/R	T/R			
RWA 1 (AH-64A)		SRE						T/R	T/R	T/R	T/R		Monitor max 2 frequencies at once
RWA 2 (AH-64A)		SRE						T/R	T/R	T/R	T/R		Monitor max 2 frequencies at once
RWA 3 (AH-64A)		SRE						T/R	T/R	T/R	T/R		Monitor max 2 frequencies at once
RWA 4 (UH-60)		SRE						T/R	T/R	T/R	T/R		Monitor max 2 frequencies at once
RWA 5 (UH-60)		SRE						T/R	T/R	T/R	T/R		Monitor max 2 frequencies at once
RWA 6 (CH-47)		SRE						T/R	T/R	T/R	T/R		Monitor max 2 frequencies at once
ARMS (KW)		ARMS Comm System (2 positions)						T/R	T/R	T/R	T/R		
ARI CGF (ITEMS)		SRM (Supplied by ARI)						T/R	T/R	T/R	T/R		Monitor max 2 frequencies at once
ARI (KW)		SRM (supplied by ARI)						T/R	T/R	T/R	T/R		Monitor max 2 frequencies at once
Classroom AAR (Not an entity)		SRM	R	R	R	R	R	R	R	R	R		**Need Speaker (4)**

Table 1 Communications Matrix

3.1.3 Tactical Simulation Interface Unit (TSIU)

The TSIU, developed by Coleman Research Corp., provided the bridge between the tactical LAN and the DIS LAN. The TSIU takes UDP formatted input from varying DIS simulations and outputs standard USMTF messages to specific ATCCS systems. Figures four, five, and six depict the data flow associated with the varying levels and types of data.

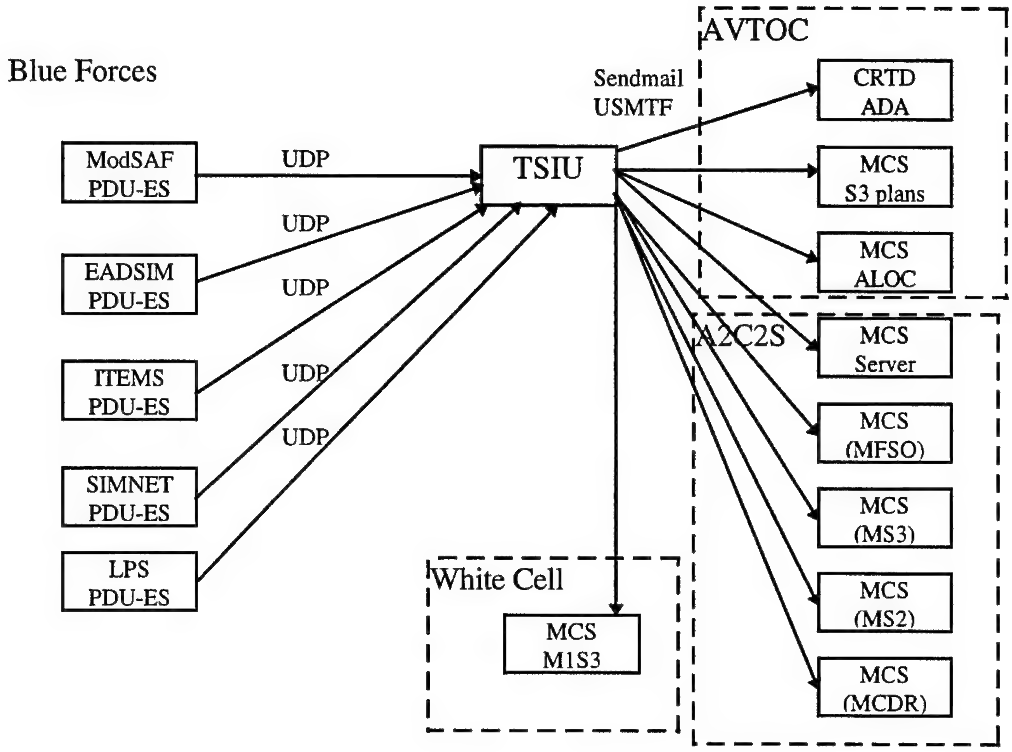

Figure 4 Blue Data Flow

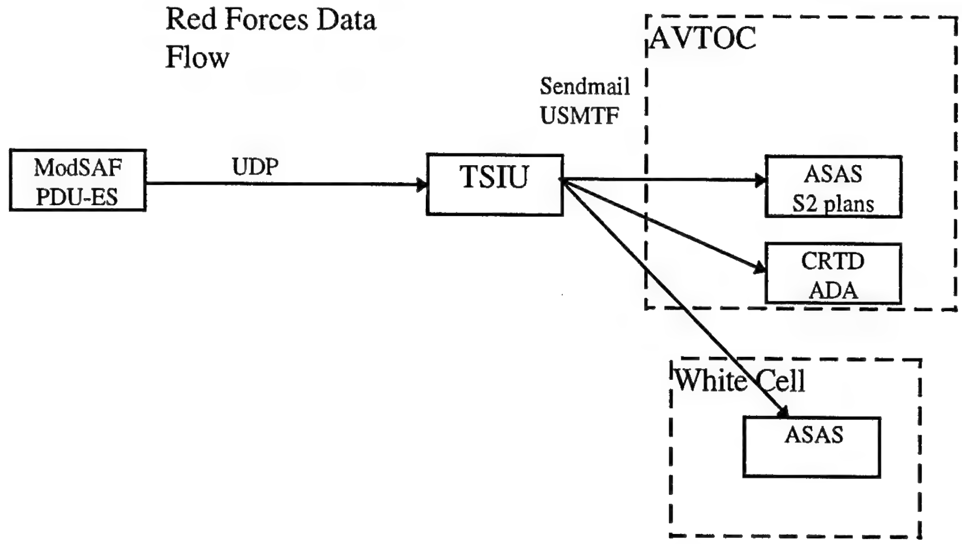

Figure 5 Red Order of Battle Data Flow

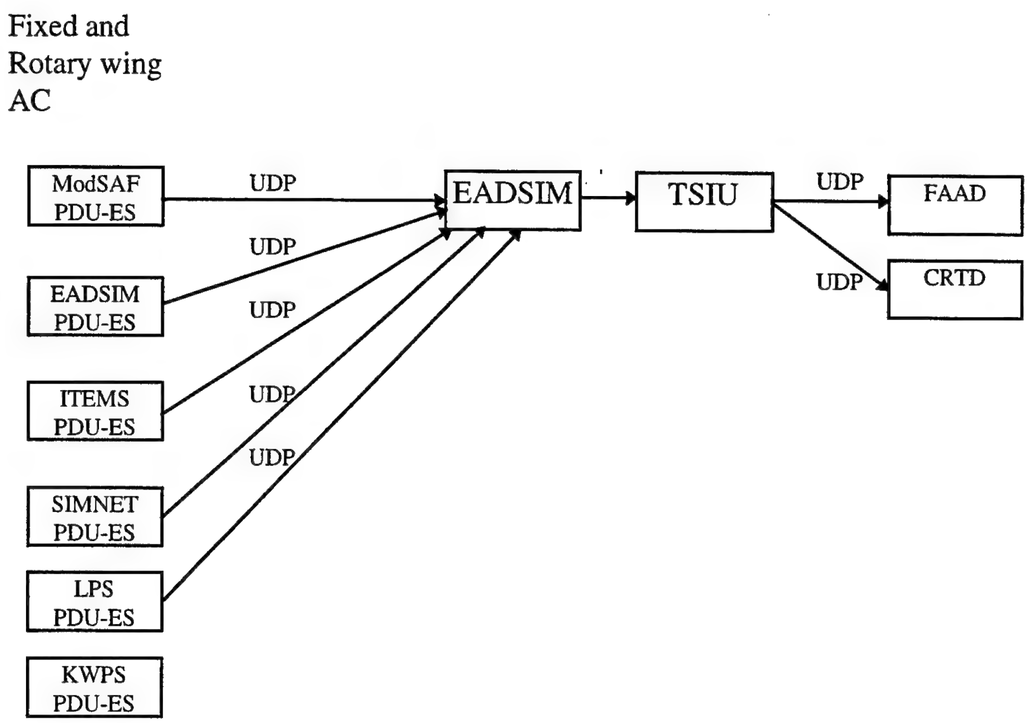

Figure 6 Air Picture Data Flow

The TSIU was hosted on a duel ethernet SUN Sparc 20 with 256 MB RAM, 4 GB Hard drive operating the Sun Solaris 2.4 operating system.

3.2 Database and Scenario Development

The existing ADST II NTC terrain database was used to support the DTX. Scenario development was provided by the Directorate of Training, Doctrine, and Simulation (DOTDS) USAAVNC.

4. Conduct of the Exercise

The training exercise was conducted over a 5 day period from 5 - 9 February 1997. The 2-4 Aviation arrived on 5 Feb. and received familiarization training with the RWAs and the tactical systems. Full scale exercises were conducted 6 and 7 February. A planning day for the final scenario was held on 8 February followed by the conduct of the final scenario on 9 February.

5. Observations and Lessons Learned

The following discussion details the lessons learned from this exercise. The lessons learned are looked at from an administrative and engineering perspective. Most comments focus on the lack of time available for integration and testing due to various problems. The original schedule provided for an integration period followed by a full scale testing period. However, due to numerous delays, the integration period was condensed and their was no time to conduct adequate testing of the DTX tactical and DIS networks.

5.1 Administrative

Observation #1

The STRICOM performed Mini-FAS information was not completely assimilated by the contractor team.

Discussion #1

The TFXXI DTX delivery order was performed with an extremely limited budget which did not allow for contractor participation during the Mini-FAS. The Mini-FAS was performed and documented by STRICOM Engineering. The Mini-FAS document provided outstanding insights into the aviation command and control process and provided a strong framework for the development of the DTX architecture. However, the lack of contractor involvement in the feasibility study creates a void in the complete understanding of the requirements.

Lesson Learned #1

For future ADST II Delivery Orders in which the FAS is conducted by the government, the contractor needs to be fully briefed on the results of the study.

Observation #2

Government Furnished Equipment and Information was not provided in a timely manner to allow for any development or integration.

Discussion #2

GFE and GFI were originally scheduled to be provided shortly after contract award. The purchase of the GFE equipment was being performed under a different delivery order (CDF Upgrades) with different priorities. Efforts were made to explore varying cost saving alternatives for equipment. However, this lead to a delay in the ordering of equipment and thus the majority of GFE was not received until one week prior to integration. The ATCCCS software was provided by TF XXI at Fort Hood one week prior to integration. These late deliveries eliminated any ability to conduct testing of the software and the DTX network. Integration continued up to the start of the exercise.

Lesson Learned #2

GFE and GFI must be closely coordinated to allow for a test and integration of systems.

Observation #3

Overtime was not planned for during the integration period.

Discussion #3

The original integration planned called for eight hour work days during the integration period at the AVTB. However, with the compressed schedule for this exercise, it quickly became apparent that twelve to fourteen hour days would be required along with working through a weekend.

Lesson Learned #3

Overtime support at the site is usually necessary to support a mid to high level integration effort.

Observation #4

Scenario development was not completed until one week prior to the exercise.

Discussion #4

The original plan for the exercise called for the scenario to be provided 45 days prior to the exercise by DOTDS. However, the completed scenarios were not provide until a week prior to the exercise. This delay in scenario development created problems in terms of the contractor understanding the number and types of entities to be used during the exercise.

Lesson Learned #4

The scenario is a critical part to the exercise. If the scenario is not ready for release, an approved entity list must be provided as a basis for conducting integration testing.

5.2 Site Integration and Exercise support

Observation #1

Appliqué machines were unreliable and unable to provide situational awareness.

Discussion #1

Appliqué version 1.01A was originally planned to be used for this exercise. The STRICOM FAS recommended the use of Joint Combat Information Terminal (JCIT) as a means for allowing the Appliqué communicate between the DIS and tactical networks. However, the JCIT had not matured to the point that it would be available for this exercise. It was then recommended that the use of the Force Protection Experiment (FPE) III application interface software be explored as a possibility. This software supported Appliqué version 1.01A and DIS 2.03 protocol. However, in January, it was decided that Appliqué Version 1.02A would be utilized and further discussed that DIS version 2.04 would be utilized. The Appliqué Interface proved to be incompatible with the new version of Appliqué and DIS 2.04. Time did not permit exploring a software solution to the problem. The deputy experiment director indicated at that time he would provide operators to manually enter situation reports during the exercise. This proved to be of little value during the exercise as the task force relied primarily on MCS for its information.

Lesson Learned #1

Several lessons learned are associated with the implementation of Appliqué. First, baseline versions of software must be identified and locked in as early as possible. Second, integration period must allow for some time to trouble shoot and develop solutions to software problems. Third, the role of Appliqué in the aviation environment must be further explored to allow for its adaptation into the simulation world.

Observation #2

ModSAF DEC Alpha machines were limited in the size marking fields it placed out to 61 markers.

Discussion #2

The TSIU reads the marking field from entity state PDUs, matches the marking field to an entry in a table of Unit Identifier Codes (UICs) and sends a USMTF format tactical message to ASAS or MCS to update the current situation. The ModSAF version 2.0 for DEC Alpha machines only put out a limited number of marking fields. A patch to fix this bug was received from the OSF within 24 hours. However, the patch lead to several other DIS related problems and proved not to be reliable. The decision was than made to tailor the scenarios such that single entities were interpreted by the TSIU> This solution proved to be acceptable for the exercise.

Lesson Learned #2

A full scale test and integration period would have identified this problem early on. Time needs to be allocated into the schedule to permit

Observation #3

Sparc 20 workstations purchased for the DTX were not equipped with floppy disk drives.

Discussion #3

The aviation task force utilized floppy disks as a means of transferring overlays and OPORDS from their laptops to the ATCCS systems. No requirement for a floppy drive had been identified prior to the integration effort and a floppy drive is not part of the standard configuration for a Sun Sparc 20. Two floppy drives were provided GFE and installed into the AVTOC and Higher Headquarters MCS machines.

Lesson Learned #3

A more detailed understanding of the requirements is necessary in order to identify the numbers and types of systems.

Observation #4

The Lightweight Computer Units (LCUs) used for the AMPS software did not have a compatible network interface nor a Tactical Communications Interface Module (TCIM).

Discussion #4

Two LCUs were provided GFE for the exercise. These systems were positioned in the Higher and Lower White Cells. The LCUs required a thin net to 10 BaseT converter in order to connect to the tactical LAN. These parts were locally procured and the LCUs were connect to the LAN. The TCIM serves as a modem between AMPS machines to allow for the passage of information. The decision had been made prior to integration not to purchase the TCIMs as a cost saving measure. An FTP work around solution was implemented which proved adequate for the exercise.

Lesson Learned #4

All hardware requirements down to the connector level must be identified prior to integration.

Observation #5

Grid zone designators did not correlate between the simulated environment and the tactical systems.

Discussion #5

The TF XXI versions of the ATCCS software switched to a new grid zone coordinate system based on the WGS datum. The simulation systems NTC data base utilized an earlier grid zone designation systems which label the area of interest with grid zone designators NK and NJ. These areas correlated to grid zone designators NV and NU in the ATCCS network. This created a correlation problem for position location passing from the simulation to the tactical environment. A short term software solution was implemented in the TSIU which converted NK and NJ to NV and NU respectively. A 200 meter error still existed after the transformation but it was considered acceptable for the exercise.

Lesson Learned #5

Terrain correlation problems must be tested prior to integration to ensure compatibility among various data bases.

Observation #6

The CDF version of the SINCGARS Radio Model did not support the NTC terrain database.

Discussion #6

A new version of the SINCGARS Radio Model was provide for the exercise under the CDF upgrade Delivery Order. This version of the SRM would not properly load nor did it contain the NTC terrain database. A decision was than made to use an older version of the SRM (Focus Dispatch) which was adequate fro the exercise.

Lesson Learned #6

Newly installed software must be fully tested and the limitation understood by site personnel prior to attempting to integrate into another exercise.

Observation #7

ASTi radio installation was more complex then anticipated.

Discussion #7

ASTi radios had not been previously utilized at the AVTB prior to the DTX. The amount of time required to run cable and install the systems was underestimated. Physically running the cabling for the radios took two days of three men all day. A communications plan was designed by the IPT and provided to ASTi who assisted in the programming of the simulation. The resulting communications network proved adequate for the DTX and the ASTi radios provided a high level of reliability.

Lesson Learned #7

Installing new systems adds a level of risk to a schedule that must be compensated.

Observation #8

The DIS network continually evolved throughout the integration period.

Discussion #8

The original DIS network called for 8 RWA's to be integrated with the Longbow Player Station and supporting ModSAF and SRE/SRM. Subsequently decisions were made to add the Kiowa Player Station and the ARMS device. The network had not been designed to incorporate the number of systems and the traffic load for this number of systems. Within the DIS network, two networks utilizing differing UDP ports were setup to keep collisions to a minimal and decrease the PDU processing load for each node. The resulting system, while less than optimal, met the requirements for the exercise.

Lesson Learned #8

The DIS network requirements need to be fully understood and locked in prior to the integration period to allow for complete testing of the system.

Observation #9

TSIU was unable to provide the complete enemy position to the ASAS.

Discussion #9

The TSIU's primary means of providing enemy information is through the S309 USMTF message. Previous versions of ASAS received an S309 message and parsed it to a database in ASAS. However, the TF XXI version of ASAS was able to receive a text version of the message but unable to parse it into the ASAS database.

Lesson Learned #9

A thorough testing period following integration must be planned for and allowed. Schedule limitations prevented this during the DTX, but this should not be a normal operating procedure.

Observation #10

There was a lack of DIS enumeration configuration management due to continuously changing requirements.

Discussion #10

The initial DIS configuration for the exercise was considered to be fairly trivial consisting of the RWA devices with the LPS and ModSAF. However, during the integration period decisions were made to include the ARMS Device and the ARI Kiowa Warrior Player Station. Along with the lack of a scenario and entities to be played, the DIS connectivity piece quickly became increasingly complicated. The number of systems on the DIS network quickly grew to a much more complicated problem. Much time and effort had to be spent trouble shooting the DIS network to identify enumeration problems.

Lesson Learned #10

All DIS systems must be decided on well prior to the integration process. A DIS enumeration configuration management planned must be developed prior to integration. Time must be allocated into the schedule to permit full testing of the network.

Observation #11

Peripheral devices were not identified early on leading to a delay in their installation.

Discussion #11

The requirement for printers on the tactical LAN was not identified prior to the integration period. The customer identified needs for printers at various locations during the integration period. The customer provided numerous printers but several were not

compatible with the LAN. Printers were not as highly prioritized by the contractor as desired by the customer. Printers were than installed on the network during the exercise.

Lesson Learned #11

All peripheral devices must be identified prior to integration so they maybe accounted for during integration.

6. Conclusion

The TFXXI DTX was extremely successful in supporting the 2-4 Aviation Task Force preparation for the upcoming live TF XXI exercise at the National Training Center. Despite an extremely compressed schedule with budgetary constrains, the integration of the tactical systems with the virtual simulations was a success. The unit was able to fully exercise all of its command and control processes within the tactical command and control network.

7. Acronyms

A2C2S	Army Airborne Command and Control System
AAR	After Action Review
ADST	Advanced Distributed Simulation Technology
AFATDS	Advanced Field Artillery Tactical Data System
ALOC	Administration an Logistics Operations Center
AMPS	Aviation Mission Planning System
ASAS	All Source Analysis System
ASTi	Advanced Simulation Technologies, Inc
AVTOC	Aviation Tactical Operations Center
ATCCS	Army Tactical Command and Control System
C2	Command and Control
C2TD	Command and Control Tactical Display
C4I	Command, Control, Communications, Computers, and Information
CDF	Core DIS Facility
CDRL	Contract Data Requirements List
CECOM	Communications & Electronics Command
CIG	Computer Image Generator

CIU	Cell Interface Unit
CSSCS	Combat Service Support Control System
DDL	Digital Data Link
DIS	Distributed Interactive Simulation
DO	Delivery Order
DOTDS	Directorate for Training Doctrine and Simulation
E-BCIS	Enhanced Battlefield Combat Identification System
EPLRS	Enhanced Position Location Reporting System
EXFOR	Experimental Force
FAAD EO	Forward Area Air Defense Engagement Operations
FAAD FO	Forward Area Air Defense Force Operations
FPE III	Force Protection Experiment III
FRAGO	Fragmentary Order
FTP	File Transfer Protocol
GFE	Government Furnished Equipment
GPS	Global Positioning System
HP	Hewlett-Packard
IG	Image Generator
H/W	Hardware
I/O	Input/Output
KWPS	Kiowa Warrior Player Station
LAN	Local Area Network
LCU	Lightweight Computer Unit
LMC	Lockheed Martin Corporation
LMSG	Lockheed Martin Service Group
MCS	Maneuver Control System
MCS/P	Maneuver Control System/Phoenix
ModSAF	Modular Semi-Automated Forces
MMW	Millimeter-Wave

MWTB	Mounted Warfare Test Bed
NRL	Naval Research Laboratory
OC	Observer Controller
OPFOR	Opposing Forces
OPORD	Operations Order
OS	Operating System
OSF	Operational Support Facility
PC	Personnel Computer
PDU	Protocol Data Unit
PM	Program Manager
POC	Point of Contact
PPP	Point-To-Point Protocol
PVD	Plan View Display
RAM	Random Access Memory
RIU	Radio Interface Unit
RP	Role Player
SAF	Semi-Automated Forces
SCO	Santa Cruz Operating System
SEIT	Systems Engineering Integration Team
SGI	Silicon Graphics Industries
SIMNET	Simulation Network
SINCGARS	Single Channel Ground and Airborne Radio System
SME	Subject Matter Expert
SOW	Statement of Work
SRE	SINCGARS Radio Emulator
SRM	SINCGARS Radio Model
STRICOM	(US Army) Simulation Training and Instrumentation Command
TF	Task Force
TIM	Tactical Internet Model

TIM	Technical Interchange Meeting
TRR	Test Readiness Review
TTP	Tactics, Techniques, and Procedures
UDP	User Data Protocol
USMTF	United States Message Transfer Format
VDD	Version Description Document
VMF	Variable Message Format